

Emerging Technology

Creator of Worlds

Many readers of *Strategic Studies Quarterly* will no doubt remember lyrics from the song “In the Year 2525,” released in 1969, written and composed by Rick Evans. For younger readers who do not remember this somewhat prescient melody consider these few lines:

Everything you think, do and say
Is in the pill you took today. . . .
Your arms are hangin’ limp at your sides
Your legs got nothin’ to do
Some machine’s doin’ that for you. . . .
You’ll pick your son, pick your daughter too
From the bottom of a long glass tube...

In the year 2016, many of these predictions have either come true, are in progress, or surely will materialize within the next 509 years. Throughout history, mankind has maintained the desire to continually expand the bounds of science and nature in search of something new—sometimes benefitting the species, at other times threatening it. Just as the nuclear revolution led to advances that would threaten the world, it also created opportunities to benefit mankind. Twenty years after the first use of a nuclear weapon, Robert Oppenheimer recalled his feelings about it, quoting from the *Bhagavad Gita*, “Now I am become death, destroyer of worlds.” Today, one can imagine, indeed, expect and rely on science to proclaim: “Now I am become life, creator of worlds.” Similarly, from nuclear weapons to nuclear medicine, current emerging technologies offer many of the same challenges and opportunities.

Consider for a moment several technologies from 20 years ago that are no longer emerging but, rather, mature and commonplace: stealth, precision, and machine automation, among others. Each of these has had a significant effect on defense, economics, and national security. In some cases, such as stealth, the effects have been especially profound, creating defense capabilities that match the dreams of airpower pioneers. In the case of machine automation, the impact transformed production for many heavy industries, yet at the same time decreased the overall need for human capital.

Surveying current emerging technologies, one finds the world is experiencing even more profound uses. Artificial intelligence, brain interface, robotics, autonomous systems, biotechnology, lasers, hypersonics, and additive manufacturing (AM) are the most prominent examples. In every case, science is pushing the limits of known capabilities or standard uses in its search for the full realm of possibilities. The partnership among science and creativity has already produced remarkable results. For instance, Google's recent computer win in the game of "Go" against a master human player indicates how far artificial intelligence has progressed. In robotics, one need look no further than most technology conferences to see fully functional robotic mules, dogs, and even "humanistic droids" able to complete a myriad of manual tasks. Not to be outdone, there now exist large and small semiautonomous drones and self-driving cars.

In the world of physics, enhancements in emerging technology manifest themselves in new capabilities, including lasers, quantum computing, and light physics. We are using lasers for help in correcting delicate vision problems and, in other uses, burning holes in metal objects or stopping moving vehicles. Even more impressive is the recent discovery of gravity waves. While the science is still evolving, eventually this discovery has the potential to change what we perceive as time, space, and matter.

Another technology that continues to emerge is AM, using a printer to create three-dimensional items. Over the past five years, companies like 3D, Organics, and Stratasys have pushed the boundaries of all traditional manufacturing techniques to produce items from a machine originally conceptualized as capable of only one dimension. The idea has progressed from printing simple, crude machine parts to creating items as durable as houses, to those as delicate as human tissues, including skin. The extent of how far this technology has emerged is evident by comparing the small plastic computer cases first produced by AM to the Chinese houses being printed today. While many uses of AM are beginning to emerge, such as onsite parts manufacturing for enhanced logistics, much greater uses are on the horizon. One can imagine the possibilities this technology can and will have in other areas—particularly if combined with other disciplines. For instance, in theory it would be possible to combine advances in biotechnology, nanotechnology, and quantum computer technology to "print" new life.

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It is in the fields of biology and medicine, however, that emerging technologies will make the most profound advancements in life as we know it. Ever since the Human Genome Project mapped human DNA and discovered all humans are 99.9 percent alike, science has been attempting to decipher the more important statistic—the remaining 0.1 percent. Already the science of medical treatments has the capability to create customized medical treatments using biotechnology, particularly in treating certain types of cancer and a variety of other ailments. Emerging technologies are also enhancing human abilities in the form of protection, strength, and wellness. The next logical step will be human enhancement starting from the cellular level. In fact, the Chinese continue research on enhancing natural intelligence through manipulating the genome with the goal of a 20 percent increase in brain function and measured intelligence. This conceptual shift will deliver results far beyond what we know today as artificial intelligence. Soon the milestone of Google's computer win at the game of Go will seem elementary compared to what will be called designer intelligence. Thus, human enhancement will become most important to the future of mankind. Such advancements are already out of the planning stage and into the demonstration and usage stages—with achievements in neuroscience, biology, and immunology. In the near future, science will be able to harness the power of the genome to correct, enhance, and create advanced forms of life. These breakthroughs will produce new challenges and new opportunities. One challenge will be to define what is considered human, ultrahuman, or subhuman. Another will be how far science should be allowed to push the boundary of normality while respecting shared notions of ethics and morality. Still another will be the question of whether to engage in the same activities as other nations or rogue scientists who do not respect limits on human enhancement. Regardless the choice or answers, the fact remains that science will evolve and unlock even more potentially harmful aspects and even greater healing opportunities.

One opportunity available will be the ability to overcome disease as we know it. In fact, these breakthroughs will allow science to redefine what is disease—that caused by nature, or that left untreated by science. Here is where the power of individual choice will become an imperative, because one will be able to choose enhancement or corrective therapy to change human conditions such as appearance, intelligence, gender,

or even sexual orientation. In the same way that science will redefine disease, society will redefine what is normal for a human being based on the realm of the possible. While the thought of artificial intelligence and human enhancement is frightening to many scholars and scientists, the irony of the future is enhanced human beings will be needed to provide controls over artificial intelligence and the machines produced by it.

Ethics and Emerging Technologies

Finally, no discussion of emerging technology would be complete without considering the ethical dimensions of the future. Several arguments emerge, on both sides of the issue, including lifesaving versus life-altering treatments, the progressive slippery slope of emerging technology, and intended versus unintended consequences.

Even in the medical community there is great debate over how far life-altering treatments should progress. On the optimistic side, many physicians and researchers see promising opportunities to prevent, reverse, or eliminate several debilitating conditions. The ethical argument becomes one rooted in traditional ethical teachings: one who has the power to save lives, prevent suffering, or mitigate damage and chooses not to do so makes an unethical choice. Those opposed tend to focus on the difference between treating disease rather than simply altering or enhancing what nature has provided. Is *normal* whatever nature provides, or is *normal* whatever is possible with what nature provides? This thinking leads to the second argument of a progressive slippery slope. The fear is “if this, then this,” assuming that if science is allowed to correct certain nuisance conditions, the result will lead to inevitable lax standards and evil ends. For example, a recent issue of *Smithsonian Magazine* asked the question, “The Last Mosquito?” Scientists have the capabilities to eradicate most—if not all—species of mosquitos responsible for malaria, dengue fever, and the Zika virus. Should they? If the world decides to do so, then perhaps rats and mice should be next. And which species will be eradicated after those? Some or most of the gene-altering capabilities can surely apply to the human species as well. While there are two sides to this argument, the answer is not mutually exclusive. If it were, the world would still be fighting most of the now-extinct childhood diseases, which relates to the third argument—unintended consequences. Many of the vaccines of the early twentieth century were results of trial and error. In some cases, those trials produced great error, and even

today, no vaccine is 100 percent safe, as we know from the few yearly deaths among those first immunized. As much as any science begins with great knowledge and a sound theory, it can only be fulfilled by trial and error—in essence, repeatable demonstrations. Emerging technologies are no different, and the ethical concerns mirror those of earlier risk periods in our history. Prudence dictates that researchers proceed with caution, but proceed they must.

While the analogy to nuclear weapons holds certain similarities, those for emerging technology will be somewhat different. The world once learned to ban chemical weapons, after nightmarish use on a large scale. Nations eventually learned how to produce arms control agreements and nonproliferation agreements for nuclear weapons and nuclear materials. However, the learning curve for this new destructive power was quite steep, and the technology has not been banned. Humanity also decided against the use of biological weapons with formal conventions, even though not all nations subscribe. Each of these scenarios provides examples of how destructive, blatantly aggressive, inhumane technologies can be controlled or eliminated. However, how does one deal with technologies that merely enhance human performance, intellect, immunity, or capacity? While they provide a distinct advantage, they do not necessarily present the kind of immediate threat of earlier weapons. Thus these will be more difficult to identify, control, restrict, and prevent.

Epilogue

The emerging technologies discussed in this article and the ones that follow are those that appear to offer the most promise for national defense. However, the technologies themselves do not provide the answers to strategic choice. For example, what tradeoffs must be made to afford such technologies, and how should the nation prioritize these opportunities? Current debates within the Department of Defense and the US Congress illustrate the tension between the realm of the possible and the reality of the necessary. While the United States cannot stop the procession of emerging technologies, not all technologies should find their way into national defense.

Many Western scholars, theologians, and scientists object to artificial intelligence, genetic modification, and human enhancement as somehow taboo. Our adversaries do not necessarily subscribe to this standard. Thus, the question for many will be whether we let our imagination,

optimism, and dreams lead the way into the future or opt to be stymied by our fears. With its disparate views of ethics and morality and seeming lack of both, the world will find it hard to restrain the nature of man to explore, progress, and change as the science of emerging technology allows. **SSQ**

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